7th International Conference on Structures in Fire – SIF' 2012 – ETH – Zürich

FIRE ANALYSIS OF A NEW STEEL BRIDGE

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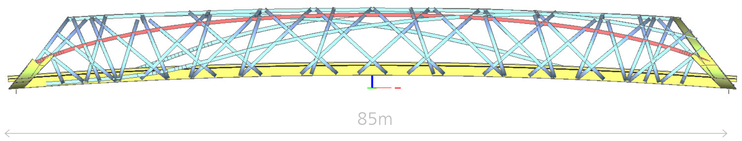
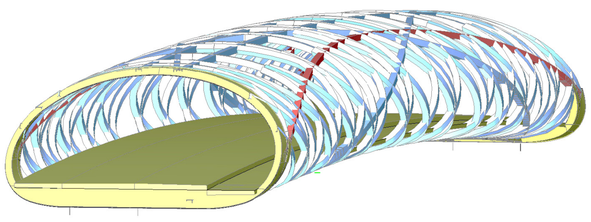
1. STRUCTURAL MODELS

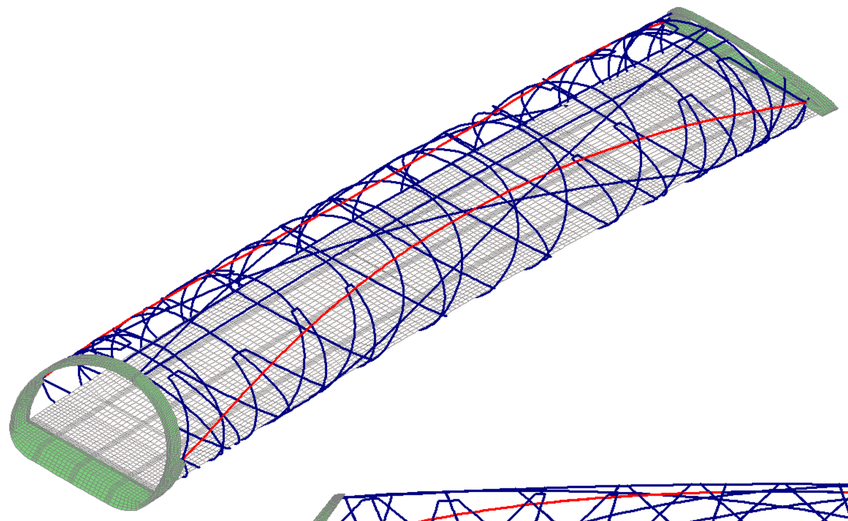


Single span bridge - 1500 tons of steel - 1500 tons of prestressed concrete



Original project : SCIA Engineer® model of the bridge

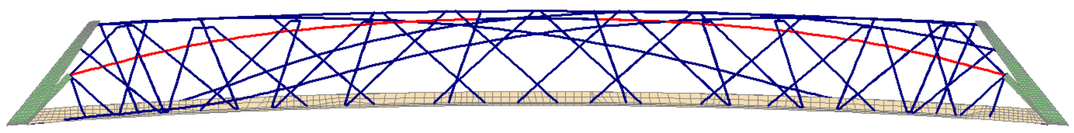
Architect : Brodbeck-Roulet – Geneva
Civil Engineer : Amsler & Bombelli - Lausanne



SAFIR® 3D structural model

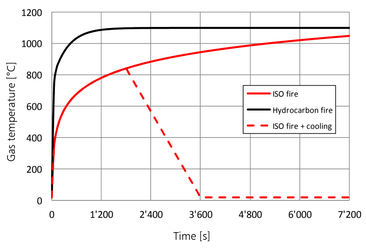
New, faster, 64 bits multicore sparse-matrix solver developed by ULG, Belgium

Biggest SAFIR ® model up today
100'000'000 equations
20'000 SHELL elements
4'500 BEAM elements
22'000 nodes

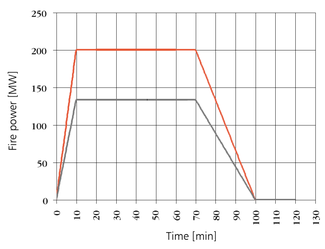


Side view : steel beams, composite beams and prestressed concrete slab

2. THERMAL ACTIONS AND CALCULATIONS



OR

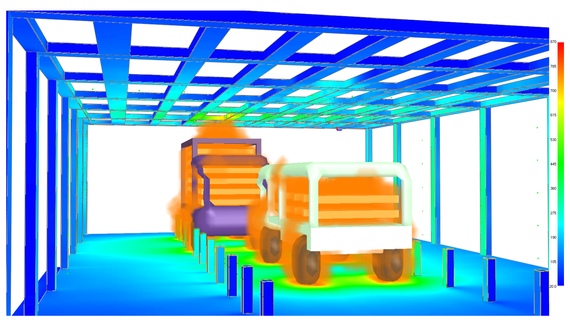


a) Normative scenarios

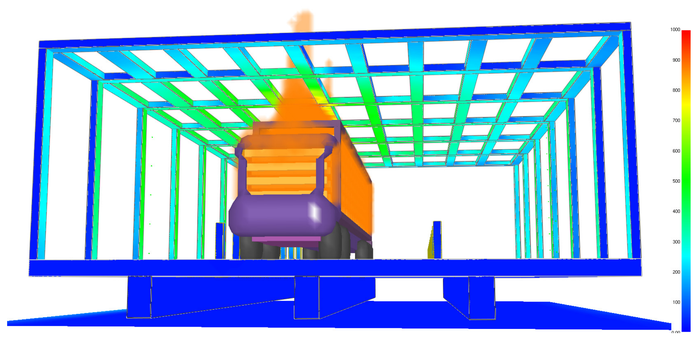
Hydrocarbon, ISO and modified ISO fire curves

b) Advanced scenarios

Fire power (Heat Release Rate) taken from tunnel scenarios



Lorry and car: 30 MW fire simulation

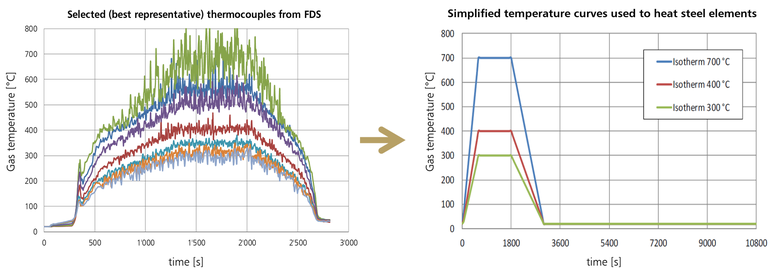


Fully loaded truck: 100 MW fire simulation

Several FDS simulations done in open air environment, with realistic modelling of vehicles and fire loads, to measure all thermal actions (convection and radiation) with virtual thermocouples.

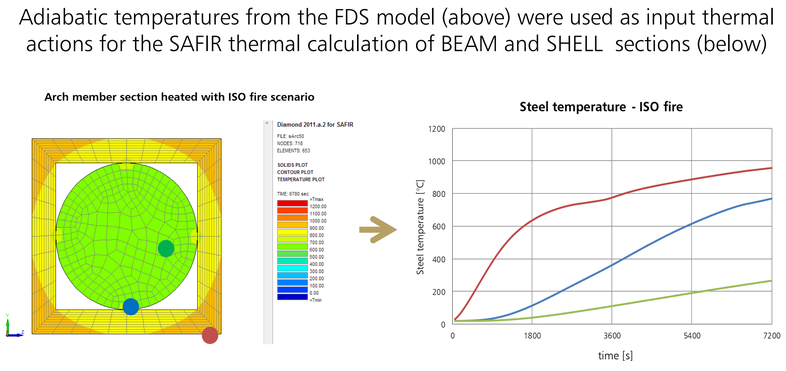
Realistic FDS simulations and data collection

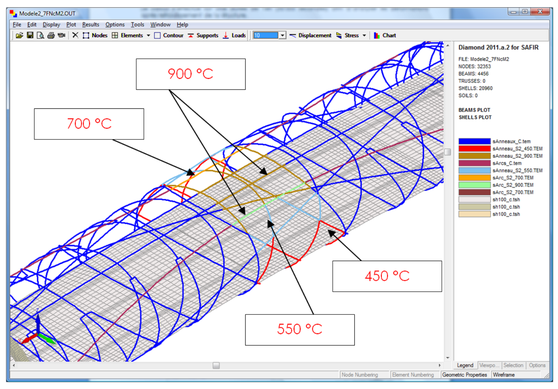
3. STRUCTURAL CALCULATIONS
Strength and limit state check



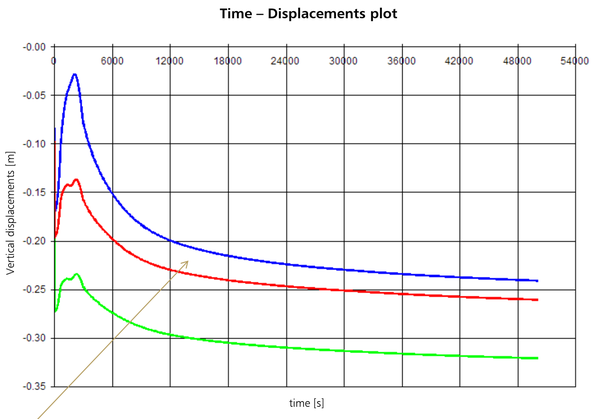
Temperature Assignment to member sections

Adiabatic temperatures from the FDS model (above) were used as input thermal actions for the SAFIR thermal calculation of BEAM and SHELL sections (below)

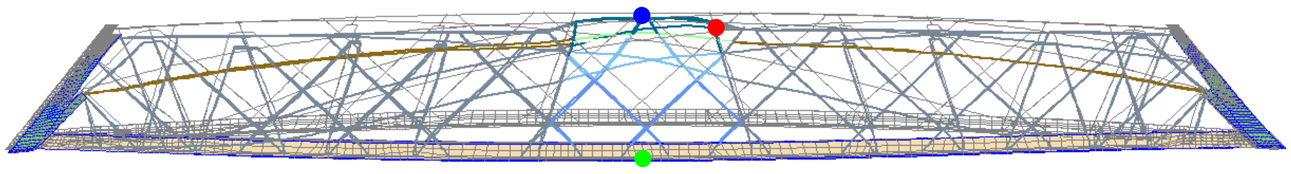




Heated section assigned to 3D structural model



Mid-span deformation with real truck fire scenario



Member section with associated thermal actions are introduced into the 3D structural model, and a time-dependent calculation is done up to the cooling of the bridge.

Structural calculations and limit states check

4. REAL BRIDGE and FUTURE WORKS

The analysis realized carried out that the «Hans-Wilsdorf Bridge» can be considered safe for the studied fire situations, and numerical simulations showed a satisfactory behavior.

A tool is currently being developed (Tondini, Vassart & Franssen, SIF' 2012) to transfer FDS results directly into SAFIR, allowing more sophisticated model analysis.